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3D Stereowide Audio Power Amplifier

Application Note

Demonstration Board - AUD4988

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1. Overview and Scope

This application note is intended to describe the 3D Stereowide Audio Power Amplifier (AUD4988) and related circuitry within its demonstration board. This document includes the schematic, PCB layout, power up procedure and application highlight

2. General Description

The AUD4988 is a 3D stereo audio power amplifier essentially designed for communication purposes, such as mobile phones and other portable devices. It can deliver 2W, per channel, of continuous average power to a 4ohm BTL load. There is less than 1% distortion from a 5V DC power supply.

The AUD4988 was specifically designed to provide high quality output power with a minimal amount of external components. It requires no output coupling capacitors. For this reason, it perfectly meets the needs of mobile phones and other low voltage applications which require the smallest amount of power to operate.

The AUD4988 adds a selectable 3D stereowide function to provide the 3D stereo imaging effect. The 3D stereowide function can be adjusted by the external capacitor to meet user requirements.

To optimize the external components, AUD4988 is built into the gain network with preset gain of (Av = 2, 2.8, 4, 5.6 & 8).

3. Feature

Product	Description	Gain (Av)	Supply Voltage (V)	Vos (mV) Limit	PSRR (dB)	x-talk (dB)	IQ (mA)	Package
AUD4988A	2 x 2W High PSRR 3D Stereowide Audio Amplifier with Shutdown Mode	2	2.7 to 5.5	30	64	80	2.5	DFN-14
AUD4988B		2.8	2.7 to 5.5	30	64	80	2.5	DFN-14
AUD4988C		4	2.7 to 5.5	30	64	80	2.5	DFN-14
AUD4988D		5.6	2.7 to 5.5	30	64	80	2.5	DFN-14
AUD4988E		8	2.7 to 5.5	30	64	80	2.5	DFN-14

4. AUD4988 Application – Demonstration Board

The AUD4988 demonstration board uses AUD4988 DFN14 package with 3D stereowide audio application. The demonstration board schematic is shown on Figure 1, while the PCB layout is on Figure 3 and Figure 4. The AUD4988 application is preset to the single-ended audio amplifier with gain = 2, 2.8, 4, 5.6 or 8. The shutdown mode and 3D mode can be controlled by J1 and J2, respectively (see Table 2 for more details).

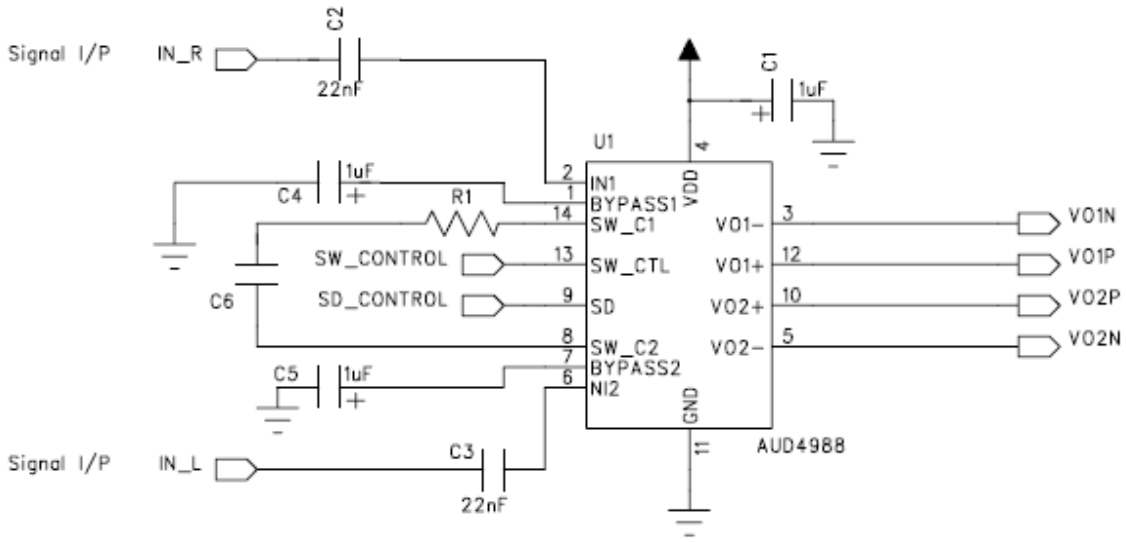


Figure 1 – Demonstration Board Schematic (Amplification)

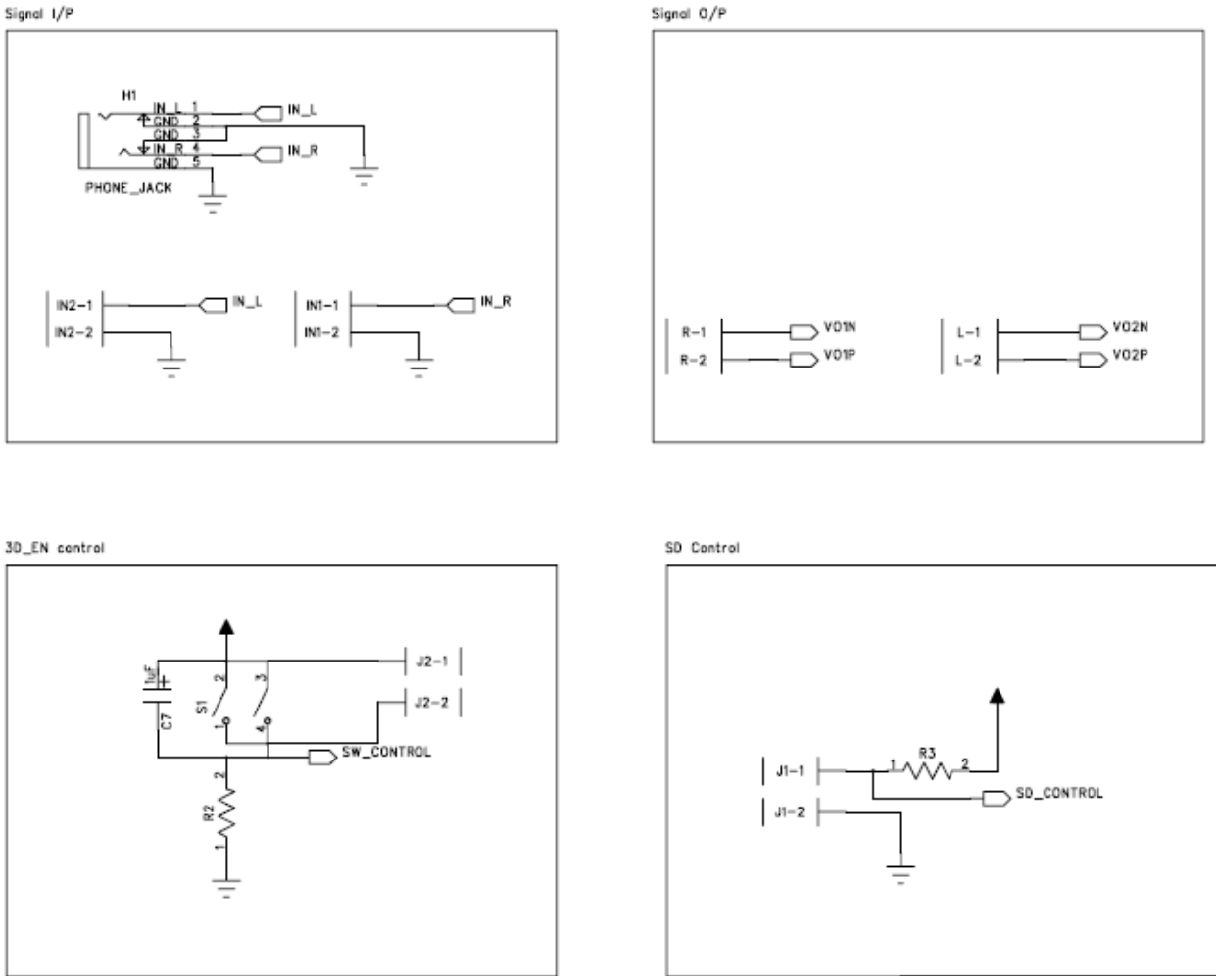


Figure 2 – Demonstration Board Schematic (Control and Input / Output)

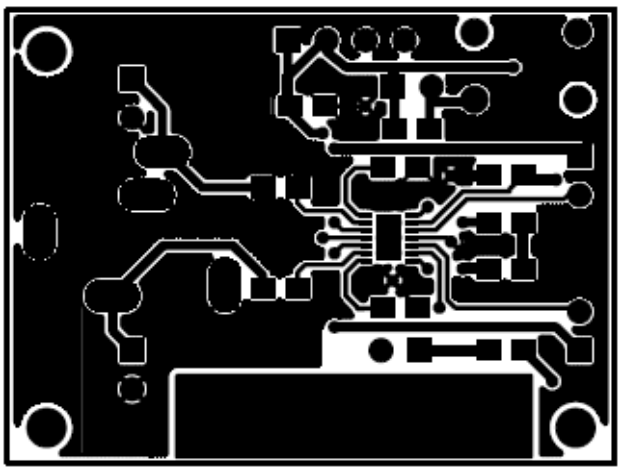


Figure 3 – PCB Layout (Top View)

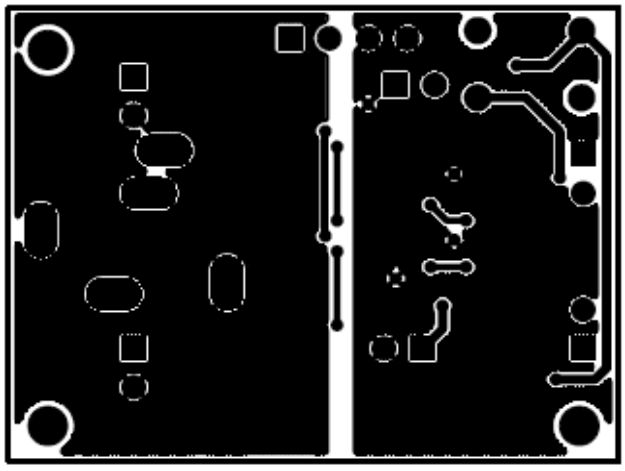


Figure 4 – PCB Layout (Bottom View)

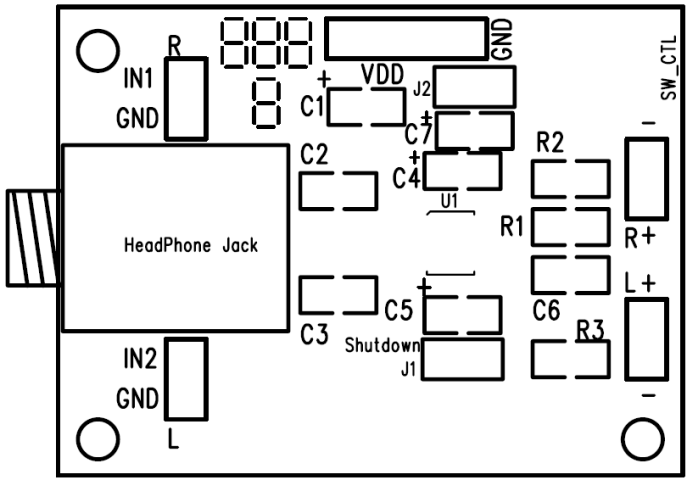


Figure 5 – PCB Components

J1 (Shutdown)	CH1/CH2 - Status
Short	Shutdown
Open	On

SD mode and SD pins cannot be left floating, they must be connected to V_{DD} or V_{SS}

After shutdown, the 3D effect will preset to Level 0

Table 1 – Shutdown Configuration

J2 (3D Control)	Present Status	Next State	Remarks
↑	Level 3	Level 2	Initial
↑	Level 2	Level 1	
↑	Level 1	Level 0	
↑	Level 0	Level 3	

3D effect will be Level 3 initially due to the capacitor being parallel with the switch and the SW_CTL set to HIGH. Otherwise, the 3D effect will be Level 0 if the SW_CTL is at LOW initially

There are 4 levels in the 3D effect, changed by the raising edge on the pin SW_CTL

Table 2 – 3D Mode Configuration

5. Components Description

Part #	Description
U1	AUD4988 DFN-14
VDD	AUD4988 Power supply input (2.7V~5.5V)
GND	AUD4988 Ground
In1, In2	AUD4988 Single end audio input. Signal ground connects to GND
R+, L+	AUD4988 CH1 and CH2 BTL output. Negative differential output marked as (-)
C1	Power supply bypass capacitor for filtering (Note 1)
C2, C3	Input coupling capacitor of AUD4988 at input terminals. It can block the DC voltage of input signal. It also acts as a high-pass filter
C4, C5	Bypass capacitor for half-supply filtering (Note 1)
R1, C6	The 3D effect setting (Please consult Analog Express)
C7	Decoupling capacitor to avoid switch debounce detection
R2	Pull down resistor which provides the logic low level to 3D control (SW_CTL) pin
R3	Pull up resistor which provides the logic high level to Shutdown (SD) pin
J1	To enable / disable shutdown feature (refer to Table 2 for detail setup)
J2	To enable / disable 3D feature (refer to Table 2 for detail setup)
Headphone jack	3.5mm stereo headphone jack socket

Note:

1. Power supply/half supply bypass capacitor is used for filtering power supply noise to maximize the power supply rejection and reduce the noise. The bypass capacitor should be placed as close to the device's power supply pins on the PCB layout. Selection of power supply capacitor will affect the PSRR requirement, click and power performance and the cost. Large input capacitor isn't cost effective and wastes PCB area. In typical applications, bypass power supply capacitor with 1uF is recommended to optimize the click and pop performance.

6. Power Up Procedure

i) Set AUD4988 in shutdown mode (Shutdown = J1 Short)

ii) Set initial 3D effect by J2

iii) Apply V_{DD} voltage to AUD4988 (V_{DD} = 2.7V ~ 5.5V)

iv) Input the signal to In1 / In2 / stereo headphone pin

v) Exit the shutdown mode by setting shutdown = J1 open

7. Application Highlight

1. All logic inputs to the IC must be low or high and cannot be left floating.
2. IN input range is related to the V_{DD} voltage supply. If the IN input is too high the output will be cropped with poor THD+N reading.
3. Audio amplifier gain is preset for the gain 2, 2.8, 4, 5.6 and 8 times. Higher gain will provide the higher output with the same signal input. However the THD+N will be also degraded, as the noise will be amplified at the same time.
4. Stereo phone jack signal input is connected to ground when not connected to the stereo phone plug. When In1 / In2 is used as the input terminal, the stereo phone plug needs to be connected to the stereo phone jack, otherwise the In1 / In2 pins are shorted to ground.
5. Power Dissipation

   Power dissipation is a major concern item for designing an amplifier. The power dissipation of AUD4988 (per channel) is four times that of a single-ended amplifier. The power dissipation equation is derived from eq2:

$$P_{DT} = \frac{1}{R_L}\left(\frac{8}{\pi}\sqrt{\frac{P_{OUT}R_L}{2}}\frac{V_{DD}}{2} - P_{OUT}R_L\right) \quad \text{.....(eq1)}$$

   where:

   P_{DT} denotes the power dissipation for the BTL amplifier

   P_{OUT} denotes the power output

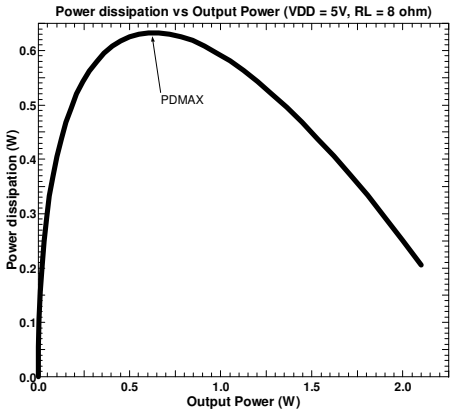
   R_L is the resistance of the load

   V_{DD} denotes the supply voltage

7. Maximum Power Dissipation

Maximum Power Dissipation is deviated from eq1. It is critical parameter to prevent thermal shutdown in normal applications:

$$P_{DMAX} = \frac{4 * V_{DD}^{\ 2}}{2\pi^2 R_L} \quad \text{.....} (eq2)$$



8. Thermal Background

To prevent thermal shutdown (TSD) in a normal application, the max power dissipation and IC's junction-to-case thermal resistance must be consider for designing an amplifier.

The maximum power dissipation should not case the IC thermal shutdown and it can be found in eq4:

$$P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA} \quad \text{.....} (eq4)$$

where:

P_{DMAX} denotes the maximum power dissipation

T_{JMAX} denotes the maximum junction temperature

T_A denotes the ambient temperature

θ_{JA} denotes the junction-to-case thermal resistance

8. Application Example

AUD4988 is suitable for many applications, such as smartphones, PDAs, MP3 players, and portable media players.

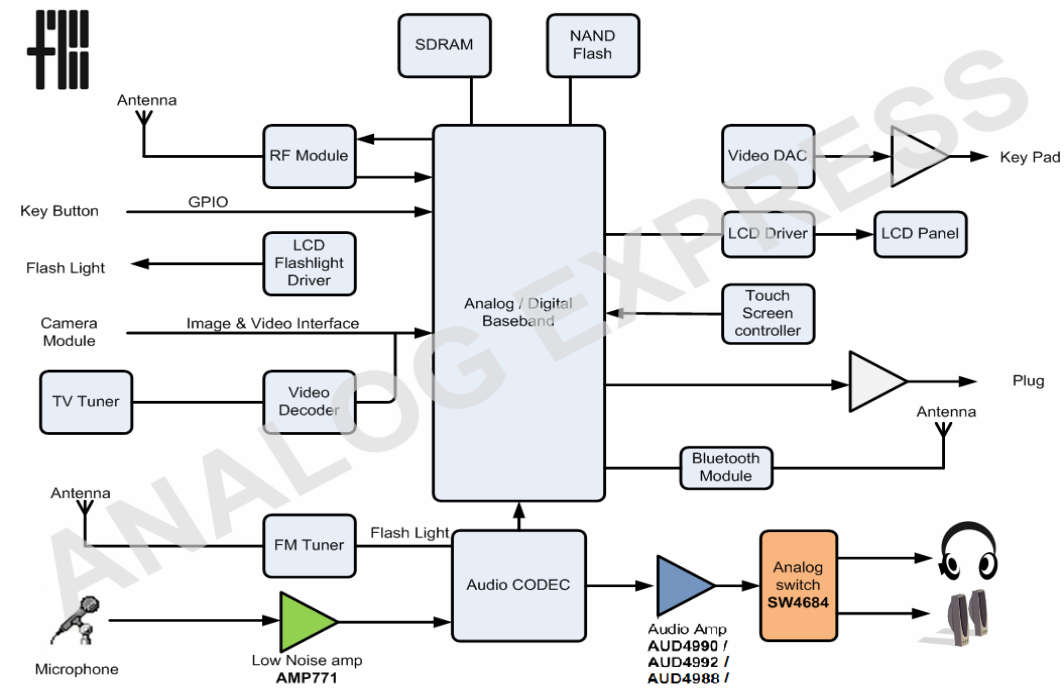


Figure 6 – Smart Phone

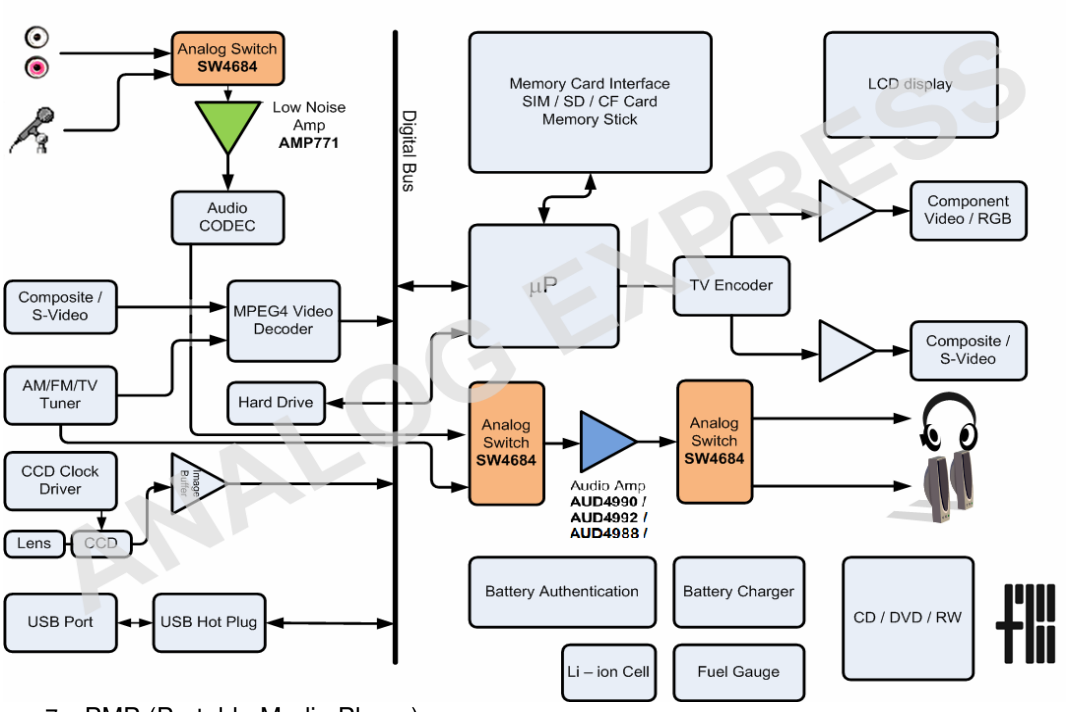


Figure 7 – PMP (Portable Media Player)

9. AUD4992 and AUD4988 Combo

AUD4988 and AUD4992 have mutually compatible input / output. Application designers can use same circuit for AUD4988 and AUD4992, which enables flexibility for custom 3D and stereo versions for their products.

The Combo schematics are shown below for the engineers who want to it for their 3D and stereo products.

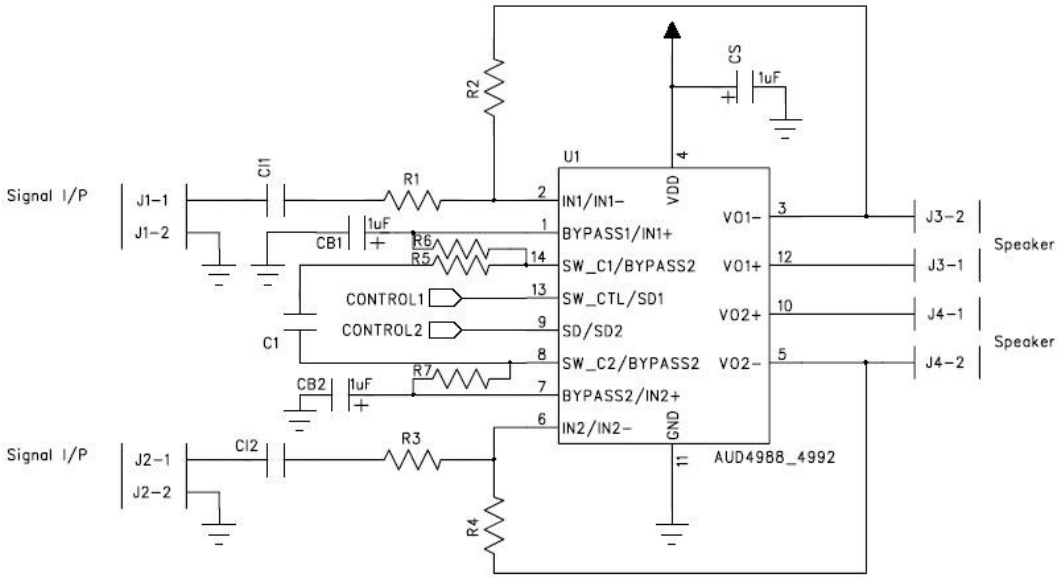


Figure 8 – AUD4992 and AUD4988 Combo Board Schematics

For AUD4992, R5 = Open; R6, R7 = 0ohm

For AUD4988, R1, R3 = 0ohm; R2, R4, R6, R7 = Open; R5, C1=it depends on the 3D stereowide setting

10. Battery Requirements

For the demo board supply, both power supply and battery can be used.

Lithium-ion 3.6V to 3.7V batteries are highly recommended. When charging the Li-ion battery, 4.2V and not more than 1A current is applied normally. The charging time depends on the charging current and the volume of the battery.

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Stereo Audio Power Amplifier Application Note
Revision History

Version	Modify Date	Description	Modified By	Release Date
1.0	14-Jan-08	Initial	Louis Cheung	